

CLAIMS

1. A laser array architecture, comprising:

an array of laser fiber amplifiers;

a master oscillator generating a pump signal at a fundamental frequency  $\omega$ ;

means for coupling the pump signal into each of the laser fiber amplifiers;

at least one array of linear crystals functioning as harmonic generators;

means for coupling amplified pump signals from the laser fiber amplifiers into respective linear crystals, which generate an array of output sub-beams at a desired harmonic frequency  $n\omega$ ;

means for detecting phase differences in the output sub-beams; and

a plurality of phase modulators for adjusting the phases of the laser amplifier input signals in response to the detected phase differences, resulting in phase coherency among the output sub-beams.

2. A laser array architecture as defined in claim 1, wherein the means for detecting phase differences comprises:

optical splitting means for obtaining a sample of each of the output sub-beams;

a frequency shifting device connected to vary the frequency of a selected one of the output sub-beam samples; and

a multi-element detector array, each element of which records the result of interfering one of the sub-beam samples with the selected frequency-shifted sample, and generates a phase difference signal;

wherein the selected output sub-beam is used as phase reference and the other sub-beams are adjusted to be phase coherent with the selected sub-beam.

3. A laser array architecture as defined in claim 1, wherein:

the at least one array of linear crystals comprises a single array of linear crystals functioning as second harmonic generators (SHGs); and

the output sub-beams are at the second harmonic frequency  $2\omega$ .

4. A laser array architecture as defined in claim 1, wherein:

the at least one array of linear crystals comprises a first array of linear crystals functioning as second harmonic generators (SHGs) and an additional array of linear crystals cascaded with the first array and also functioning as second harmonic generators (SHGs); and

the two cascaded arrays of SHGs produce an output with a fourth harmonic frequency  $4\omega$ .

5. A laser array architecture as defined in claim 1, wherein:

the at least one array of linear crystals comprises a first array of linear crystals functioning as second harmonic generators (SHGs) and an additional array of linear crystals cascaded with the first array and functioning as sum frequency generators (SFGs) to mix the outputs of the first array with the fundamental frequency; and

the two cascaded arrays of SHGs produces an output with a third harmonic frequency  $3\omega$ .

6. A laser array architecture as defined in claim 1, wherein:

the at least one array of linear crystals comprises a first array of linear crystals functioning as second harmonic generators (SHGs) and at least one additional array of linear crystals cascaded with the first array; and

the cascaded arrays of linear crystals produce an output with a desired  $n^{\text{th}}$  harmonic frequency  $n\omega$ .

7. A method for generating, from an array of laser fiber amplifiers, a high power coherent output beam at a desired wavelength in the visible or ultraviolet regions of the spectrum, the method comprising the steps of:

generating in a master oscillator a pump signal at a fundamental frequency  $\omega$ ;

coupling the pump signal to each of element of the array of fiber amplifiers;

coupling the amplified pump signal from the array of fiber amplifiers into corresponding elements of an array of nonlinear crystals functioning as harmonic generators;

generating in each element of the array of nonlinear crystals an output signal with a frequency,  $n\omega$ , that is a desired harmonic of the fundamental frequency, to provide an array of output sub-beams;

detecting phase differences in the output sub-beams; and

adjusting the phases of the laser amplifier input signals in response to the detected phase differences.

8. A method as defined in claim 7, wherein the step of detecting phase differences comprises:

splitting off a sample of each of the output sub-beams;

frequency shifting a selected one of the output sub-beam samples; and

interfering each one of the sub-beam samples with the selected frequency-shifted sample in a detector array, to generate a phase difference signal;

wherein the selected output sub-beam is used as phase reference and the other sub-beams are adjusted to be phase coherent with the selected sub-beam.

9. A method as defined in claim 7, wherein the step of generating output signals comprises:

generating output signals at a second harmonic frequency  $2\omega$  in an array of second harmonic generators (SHGs).

10. A method as defined in claim 7, wherein the step of generating output signals comprises:

generating output signals at a second harmonic frequency  $2\omega$  in a first array of nonlinear crystals, functioning as second harmonic generators (SHGs); and

generating output signals at a third harmonic frequency  $3\omega$  in a second array of nonlinear crystals cascaded with the first array and functioning as sum frequency generators (SFGs) to mix the second harmonic signals with the fundamental frequency.

11. A method as defined in claim 7, wherein the step of generating output signals comprises:

generating output signals at a second harmonic frequency  $2\omega$  in a first array of nonlinear crystals, functioning as second harmonic generators (SHGs); and

generating output signals at a fourth harmonic frequency  $4\omega$  in a second array of nonlinear crystals cascaded with the first array and functioning as second harmonic generators (SHGs).

12. A method as defined in claim 7, wherein the step of generating output signal employs multiple cascaded arrays of nonlinear crystals performing selected functions to produce an array of output sub-beams at the selected harmonic frequency  $n\omega$ .